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ASYNCHRONOUS TRANSFER MODE SYSTEM AND METHOD TO VERIFY A CONNECTION

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ASYNCHRONOUS TRANSFER MODE SYSTEM AND METHOD TO VERIFY A CONNECTION

TECHNICAL FIELD OF THE INVENTION

[0001] This disclosure relates generally to Asynchronous Transfer Mode data networks, and particularly but not exclusively relates to a signal reflection and trace function on an Asynchronous Transfer Mode transmission device.

BACKGROUND

[0002] Asynchronous Transfer Mode (ATM) is a dedicated-connection, cell switching, data network protocol and technology. ATM organizes digital data into constant length cells, and switches these cells between transmission devices according to specified protocol. In ATM, connection data is switched between a source transmission device and a destination transmission device across a data path (or circuit or data pipe). In ATM, connection control signals are switched between the source transmission device and the destination transmission device across a signaling path (or signaling circuit or signaling pipe) that is separate from the data path.

[0003] In ATM, because the data and the control signals are each transmitted across the separate pipes, verifying a signaling connection is not the same as verifying that a data communication can or has been made. And in ATM, if a connection has been set up meaning that the signalling path has been established, the data path may not be established; or if the data path has been established, the data path may not transmit data properly, and thus data transmissions may be flawed. What is needed is an apparatus and a method to verify that a data path has been established. Current systems and methods do not verify that the data path transmits data from a source transmission device to a destination transmission device

device, and from the source transmission device to the destination transmission device without error.

[0004] In ATM, a data pipe is generally formed by a connection from a source transmission device through a sequence of a plural number of intermediate transmission devices to the destination transmission device. Each time a packet is forwarded through an intermediate transmission device, a "hop" occurs. Any data path can take a plural number of routings from the source transmission device to the destination transmission device. The more hops, the longer it takes for data to go from source to destination. Current systems do not tell users how many hops there is along the data path from the destination transmission device to the source transmission device, the identity of each intermediate transmission device, and how long each intermediate transmission device takes to process a hop.

SUMMARY OF THE INVENTION

[0005] A system to transmit an ATM data message on an ATM network from a source transmission device to a destination device, and reflect at least a portion of the data received by the destination transmission device back to the source transmission device where it is compared to the data that was transmitted from the source transmission device is described. One embodiment of the invention includes an ATM transmission device having a destination hold circuit to hold a determined selector identification; a first destination receive circuit to receive a setup message having a first selector content and establish a connection; a second destination receive circuit to receive on the connection a first ATM data message having a first data from an ATM source transmission device; a destination read circuit to read the first selector content and compare the first selector content to the selector identification; and a destination compose circuit to compose a second data message having a transmitted second data based on the received first data and an address of the source transmission device and send the second data message if the first selector content corresponds to the determined selector identification.

[0006] Other features and advantages of the present invention will be apparent from the accompanying drawings and from the detailed description that follows below.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] The present invention is illustrated by way of example and not limitation in the figures of the accompanying drawings in which like references indicate similar elements and in which:

[0008] Figures **1a** - **1d** is a flowchart illustrating the operation of an ATM source transmission device in transmitting a message to-be reflected from the ATM destination

transmission device and in transmitting received trace data to a user interface, and the destination device in reflecting the received message.

[0009] Figure **2** is a block diagram of an ATM transmission device.

[0010] Figure **3** is a user display of received trace data transmitted from an ATM source transmission device to the user display.

DETAILED DESCRIPTION OF THE ILLUSTRATED EMBODIMENTS

[0011] Figure **1a** - **1d**, is a flowchart describing the operation and circuit characteristics of an ATM source transmission device in transmitting a message to be reflected from the ATM destination transmission device and in transmitting received trace data to a user interface, and of the destination device in reflecting the received message. As portrayed below, the destination transmission has circuitry to listen for a determined address selector code, and the source transmission device has circuitry to encode an address selector code conforming to the destination address selector code. The destination transmission device upon reading the selector byte, reflects at least a portion of the data back to the source transmission device, that compares the sent data and the received data to evaluate whether the data connection has corrupted the transmission.

[0012] An embodiment includes in block **104** a user requesting a connection setup on an ATM network, and a verification of the data connection.

[0013] In block **109**, the ATM network source transmission device, and preferably a computing entity on the ATM network source transmission device responding to a stored computer program, conventionally establishes up a call connection with a specified ATM network destination transmission device. In order to establish the connection, the source

transmission device fills in the information elements (or service parameter data) for the connection. This service parameter data includes a traffic descriptor, QOS parameter, and other data well known to those skilled in the pertinent art, that are individually user specified or filled in from default values. The destination transmission device address is conventionally obtained and is alternatively a name or an address. The ATM network destination transmission device has preferably registered its network address and with the network name server and is ready to receive signaling messages on this address, i.e. ready to listen on this address.

[0014] The address includes the reflection service selector code byte for the reflection service in the destination transmission device. An ATM network does not route on the selector byte field of an address, but the addressed node distinguishes the selector byte for routing within the node to different services, functions, or entities, within the node. In the present invention, a determined selector byte code is reserved for a routing to the message reflection service of the present invention, wherein a destination transmission device listens for the reflection service selector code byte, and if an incoming message indicates that byte, the incoming data message is reflected back to the source transmission node (or device) as will be presently disclosed.

[0015] The source transmission device acquires the reflection selector code of the destination transmission device. In a preferred embodiment, all transmission devices in an ATM network provide a signal reflection service (or server) trigger on the same selection code. In another embodiment, the selection codes in at least two transmission devices are different selection codes, and a source transmission device will have the selection code for the

connection destination transmission device, whether by storing it as a predetermined value, receiving it, or deriving it according to an algorithm.

[0016] In block **114**, the source transmission device attaches a pathtrace information element to the call setup signaling message built in block **109**. In other embodiments of the present invention, the source transmission device instead attaches a trace information element to a message where in current ATM protocol, a trace information element is for an already existing connection, and not a pathtrace which is for a new connection. In block **118**, the source transmission device transmits the call setup signaling message to the destination transmission device address (or name).

[0017] In block **122** the setup signaling message composed and transmitted by the destination transmission device in blocks **109** - **118** above is received by the source transmission device, preferably a computing entity of the source transmission device responding to a stored program on the source transmission device.

[0018] In block **125**, the destination transmission device determines in response to the received setup signaling message, whether the required parameters are acceptable and composes and transmits to the source transmission device a response message that is alternatively a connect message for allowing the call to go through, or a release message for releasing the connection. The destination transmission device of the present invention includes a message reflection service of the present invention on a determined selector byte. A destination transmission device listens for the reflection service selector code byte, and if an incoming message indicates that byte, the incoming data message is reflected back to the source transmission node (or device).

[0019] In block **129**, the source transmission device receives the response message from the destination transmission device and determines whether it is a connect message or a release message.

[0020] If the response message in block **129** is a release message, control passes to block **133**. In block **133** the source transmission device reads the cause code of the release message and depending upon the cause code and user direction, alternatively does or does not issue a release retry to the destination transmission device and outputs the cause code to the user via a user interface on a circuit path such as a User Network Interface (UNI). The source transmission device optionally sends the received pathtrace hop data from the destination transmission device and the intermediate transmission devices to the user via a user interface on a circuit path, in an optionally reformatted presentation.

[0021] If the response message in block **129** is a connect message, control passes to block **140**. In block **140**, the source transmission device accepts the connection and signals to the destination transmission device an allowance of the connection to be successful.

[0022] In block **144**, the destination transmission device has read the selector code byte of the transmitted setup message, compared it to a held selector code, and found a correspondence between the held selector code and the selector code sent in the setup message, where correspondence may mean an identity, an identity of at least one byte, or an identity of an algorithmically modified selector code. The destination transmission device is set to reflect back an at least one subsequent data message from the source transmission device for the current connection.

[0023] In block **148** the source transmission device optionally stores and/or sends the received pathtrace hop data from the destination transmission device and the intermediate

transmission devices to the user via a user interface on a circuit path, in an optionally reformatted presentation, and optionally sends to the user an indication of a successfully established signaling path.

[0024] In block **164**, the source transmission device composes and sends to the destination transmission device a data message. The data message is according to the option parameters specified in block **109**, and data message parameters such as packet mode, streaming mode timestamp, and checksum, either as specified or as default values, well know to those skilled in the pertinent art.

[0025] In block **170**, the destination transmission device receives the data message transmitted by the source transmission device in block **164**. In block **178**, the destination transmission device prepares and transmits a reflection of the received data message to the source transmission device. The reflection includes a reflection of all the input data, a reflection (or identity of at least a portion of the data), or an algorithmically altered selection of a least a portion of the input data, wherein it is preferred that all data be reflected back without any alteration.

[0026] In block **184**, the source transmission device receives the data message from the destination transmission device and compares the received data with the transmitted data, according to whether the reflected received data is all the transmitted data, a portion of the transmitted data, or an algorithmically altered at least a portion of the transmitted data, as specified in block **178**. In block **187**, the source transmission device optionally outputs the connection statistics to the user.

[0027] Referring now to Figure **2**, an ATM transmission device circuit **204** includes an embedded processor **210** programmed to execute the operations of the signal reflection server

and pathtrace/.trace display server of the present invention. The processor **210** is coupled to a RAM/ROM **230** that stores the coded instructions for the processor **210** to execute, and furnishes the dynamic storage memory utilized by the processor **210** in running the coded instructions. The RAM/ROM **230** is an embodiment of a machine readable medium which when executed by at least one processor **210**, causes the processor **210** to perform the operations comprising the ATM transmission device circuit **204** that include transmitting a data message having data to a destination ATM transmission device, and having a message address selector code to cause the destination transmission device to reflect at least a portion of the received data to the ATM transmission device circuit **204**, and causing the ATM transmission device circuit **204** to reflect at least a portion of a received data to a source ATM transmission device if the selector byte of the address corresponds to a stored selector code. The ATM transmission device circuit **204** includes a disk or other large capacity and non-volatile storage device **220**, to permanently store data.

[0028] With particularity, the processor **210** and system memory **220** and **230** together constitute at least in part a destination hold circuit to hold a determined selector identification; a first destination receive circuit to receive a setup message having a first selector content and establish a connection; a second destination receive circuit to receive an ATM data message having a data; a destination read circuit to read the selector content and compare the selector content to the reflection server selector identification; a destination compose circuit to compose a data message having data based on an input data; a compose circuit to compose a setup message having a selector content indicating a reflector server function; and a compare circuit to compare a transmitted first data to a received second data if the source transmission device receives a data message.

[0029] The ATM transmission device circuit **204** additionally includes a line driver **240** to provide an interface to the physical line or trunk which can be a large variety of embodiments including SONET/T1/E1/T3/E3. The line driver **240** converts an on line information whose embodiment may include electrical impulses or laser wavelengths into a bit stream. The ATM transmission device circuit **204** includes an ATM Cell Scheduler/Framer **250** to serve as layer 1 of the ATM protocol stack, to convert the bit stream provided by the Line Driver **240** to ATM cells. The ATM transmission device circuit **204** includes a Segmentation and Re-assembly (SAR) circuit **260** to convert the ATM cell stream into the ATM Adaptation Layer (AAL) datagram frames to the user, and to segment the packets given by the user (which may be in the form of Internet protocol datagrams or packets having no guaranteed sequential delivery) into ATM cells to be sent on the ATM network. The ATM transmission device circuit **204** includes a high speed bus **270** to transfer data within the circuit **204**. The ATM transmission device circuit **204** in an embodiment also includes a terminal **280** that may be in the form of a display, printer, keyboard and other devices to receive information from the processing unit **210** and to input information to the processing unit **210**, and is the interface through which a user or an operator runs the various commands (e.g. the reflection/trace/pathtrace function of the present invention, and in an embodiment receives the trace/pathtrace data portrayed with reference to Figure 3). The terminal **280** in an embodiment is coupled to the ATM transmission device circuit **204** through a User Network Interface (UNI) (not shown).

[0030] Referring now to Figure **3**, a transmission device of the present invention receives trace and pathtrace lists added to a data message and a setup message respectively that includes the hop data from each of the intermediate transmission devices that are in the data

path from the destination transmission device to the source transmission device. The source transmission device parses the hop data, then formats a portion of the data for transmission to a user terminal such as a display or a printer. The information output to a user is formatted according to node #, port identification, (virtual path identifier/virtual connection identifier (vpi/vci), callref. For a successful connection, each hop should be portrayed , and for a failed connection, each node till the connection failed with the cause value. A display **304** has a first line **310** for a node 1, a second line **414** for a node 2 with a port "xyz", a third line **320** for a node 2 with a port "uio", and other lines **330** for other nodes, and a last line **340** for a node N, port "<...>", wherein for each of the nodes, the vpi/vci and callref fields are left illustratively as "vpi/vci" and "callref" respectively.

[0031] Embodiments of this invention include program operations stored on a machine readable medium. A machine readable storage medium includes any mechanism that provides (i.e. stores and/or transmits) information in a form readable by a machine (e.g. a computer). For example, a machine readable medium includes read only memory (ROM), random access memory (RAM), magnetic disk storage media, optical storage media, flash memory devices, electrical, optical, acoustical or other from of propagated signals (e.g. carrier waves, infrared signals, digital signals, etc.) etc.

[0032] In the foregoing specification, the invention has been described with reference to specific exemplary embodiments thereof. It will, however be evident that various modifications and changes may be made thereto without departing from the broader spirit and scope of the invention as set forth in the appended claims. The specification and drawings are, accordingly, to be regarded in an illustrative rather than a restrictive sense.